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ABSTRACT

Described is an interdisciplinary curriculum of science and social science for the teaching of environmental education at the high school level. The curriculum is designed for use with either one or two semesters of a class meeting for 50 minutes, five times per week. The document outlines the components of the curriculum and presents extensive data and analyses of effectiveness measurements of cognitive gains in topics related to environment following intervention of the described course. (RE)

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Project CREATION

Title IVc, E.S.E.A.

Proposal Submitted to the Joint Dissemination and Review Panel
of the National Diffusion Network (N.D.N.)

June 5, 1978

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Report for Submission to
Joint Dissemination Review Panel

- I. Program Area: Secondary Environmental Education, ninth through twelfth grade, Project CREATION (Concern Regarding the Environment and Technology in Our Nation/Neighborhood)
- II. Developers: Title III, E.S.E.A., Illinois Office of Education through a grant at LaSalle-Peru Township High School, 541 Chartres Street, LaSalle, IL 61301
- Dr. Robert D. Pomije, Superintendent
Jean G. Hauser, Project Director
Dr. Arthur Yonke, Evaluation Consultant

III. Source and Level of Funding:

<u>Source</u>	<u>Development Implementation FY 74-75</u>	<u>Development Implementation FY 75-76</u>	<u>Implementation FY 76-77</u>
Title III/IVc ESEA	\$94,945.64	\$78,725.07	\$58,375.90

IV. Years of Development:

Initial Funding - July 1, 1974

State Validation - June 24, 1977

V. Description of the Project:

- A. Product/Practice: The major goal of CREATION is to develop an educationally significant, cost-feasible, exportable curriculum and methodologies, grades 9-12, in environmental education.
1. Objective - Where the curriculum is implemented, students will make significantly higher cognitive gains in environmental understandings, as measured by scores on standardized achievement tests, than students in comparison groups. In addition, students taking the course will show significantly more positive attitudes toward their environment than students in comparison groups.
 2. Curriculum - CREATION is an interdisciplinary curriculum (science/social science) at the high school level developed as an innovation in the field of environmental education. CREATION is unique in that it has developed a curriculum that provides sufficient course work for either a semester or two semester class that meets for 50 minutes, five times per week. Such a robust curriculum differs greatly from modular approaches where environmental education is interjected into classes whose primary functions are not environmental. Our review of the directory of projects/programs in environmental education published by the ERIC Information Analysis Center for Environmental Education shows no other such curriculum for secondary schools (Ohio State University, 1976).

In a 1970 report of the National Education Association it was found that only 781 of the nation's 7,143 school districts with enrollment of 1,000 or more (11%) have environmental education programs large enough to engage a half-time staff person. Most programs focus on science, rather than an integrated or interdisciplinary approach. The report also showed that of the 781 schools with environmental programs, only 25% of those offered them on a full-time basis.

3. Interdisciplinary Approach - our review of environmental programs indicates the majority are science based. CREATION has been written as an interdisciplinary course, with social science concerns as a basic component alongside science. Our lack of national commitment to cleaning-up the environment and guarding our future has often more to do with questions of jobs, special interest groups, and power politics than it does with scientific understandings. The project attempts to present a balanced view of the needs of the technological society on the one hand, and the needs of the environment on the other. It is not an either/or proposition; rather how do we reach an acceptable balance between the environment and the technology?
4. Comprehensive Design - where many environmental projects have focused on limited ecological concerns, CREATION has designed a curriculum that covers this topic from a wholistic viewpoint. Students in a semester study one of the available units in each of the four categories of pollution, energy, land use, and urban management.
5. Examination of Local Problems - when students have completed the study of a unit they have the "tools" necessary to examine a related local environmental problem. This interface of the classroom and the community allows students the opportunity to see the relevance of the curriculum in their own lives.
6. A Central Problem Solving Model - students use a problem solving model as their device for studying local environmental problems. Repetitious use of the model is designed to reinforce techniques of problem solving, whether in environmental or other academic concerns.
7. Competency-based Programmed Instruction - each of the fifteen units (divided under the four categories) is designed with specific learner-outcome objectives. Performance competencies for each objective are designated; a student does not move to new material until competency has been demonstrated for previous objectives.
8. Community Involvement - an important classroom methodology is the inclusion of community members as guest speakers on matters of local environmental concern. Local governmental officials, business and industry representatives, civic spokespersons, and EPA officials have all been valuable classroom resources for students. Such an integration with the community lends an important experiential dimension to environmental problems.

Summary: These components are all part of this educational innovation; unique in the field of environmental studies. The curriculum has been diffused as an entirely new course within a district, or as an interface with existing courses.

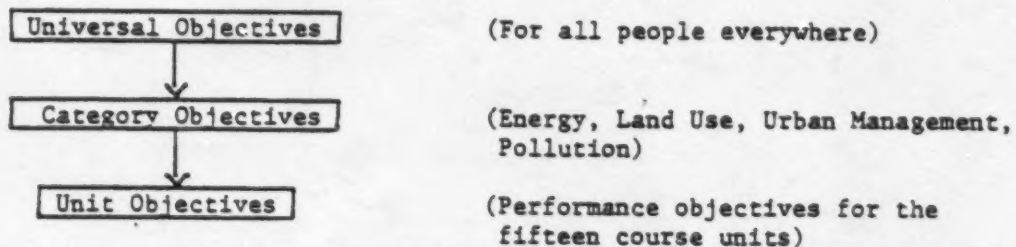
Course Objectives and Design:

The major goal of CREATION is to develop students as citizens who will hold a strong environmental ethic. By this we mean students as citizens who will support the values and actions needed to retard man's negative impact on our planet.

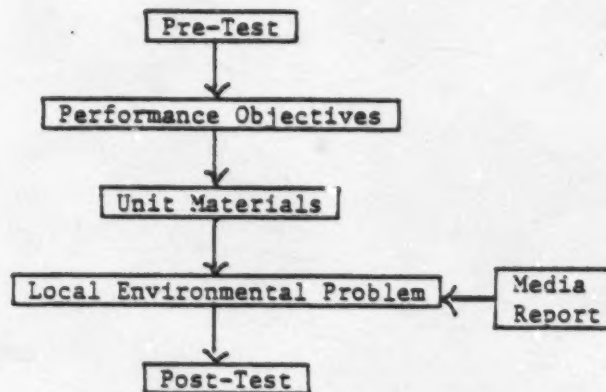
To achieve an environmental ethic, students and teachers need to understand several universal themes which run like threads through CREATION, weaving the course together and giving it relevance to all people, everywhere on the planet. These universal objectives first appeared in the Environmental Education Hand-

book for Teachers, which allows the CREATION curriculum an integration with the state plan. The universal objectives as they appear in the curriculum are: interdependence, impact, maintenance, quality of life, and improvement.

Within the course structure, environmental concerns have been divided into four broad categories: energy, land use, urban management, and pollution. Each of these four broad categories contains its own specific objectives; so no matter which unit under a category a student might study, he or she will understand the unit, the objectives under that category, and the universal objectives for the entire course.



A student chooses at least one unit under each category during a semester. The model below reflects the working design of the course curriculum.



- B. Effectiveness: As a result of the course intervention, students in the CREATION group increased their scores from pre to post tests in cognitive environmental understandings at a .05 level of significance over scores of students in other environmental education, science and social science courses and programs. These gains were identified during the 1975-76 and 1976-77 school years with different experimental and control groups. Additionally, attitudinal changes were evidenced in the 1975-76 study which significantly favored the experimental group. These gains were also noted in the 1976-77 study, however, a revised instrument was used in the 1976-77 study. Direct comparisons should be made in light of this fact.

Five control groups were used to control for such variables as maturation, history, program/course differences, teacher background and training and John Henry and Hawthorn Effects.

The comparison groups identified and utilized offered the most stringent test for the experimental group. Several of the control groups were comprised of students in select course areas: e.g. chemistry, T.H.I.S. (an experimental science program), outdoor orientated science program and an established environmental educa-

tion course. Matching of experimental and control groups was based on four selected variables: IQ, mobility data, merit scholar production, and selected teacher variables as measured by a twenty-seven item position survey.

National and local designed and standardized instruments were utilized for measurement of effectiveness. See Section V.E.

Evaluation instruments used to measure student response changes were:

1. Morehead Environmental Awareness Test
2. Test of Reasoning in Conservation
3. Levels of Environmental Understanding Test

The Morehead Environmental Awareness Test was used in the 1975-76 and 1976-77 studies as a measure of cognitive gain in topics related to environmental awareness. The intent of the evaluation was to determine the significance of the gain or loss of student scores on this measure after the course intervention. Table 1 provides a summary of the results of the 1976-77 study. Similar results from the 1975-76 study were obtained, $F(4,310) = 3.754$, $p < .003$ on the Morehead Environmental Awareness Test.

Table 1

Pre and Post Test Mean Standard Deviation and Mean Gain Scores
Morehead Environmental Awareness Test
1976-77 School Year

		Pre	Post	Mean* Gain
CREATION (Experimental)	Mean	55.6470	63.091	7.362
	SD	8.268	10.957	
	N	54	54	
LaSalle-Peru THIS Science (Control)	Mean	58.209	59.171	0.962
	SD	11.191	11.852	
	N	32	32	
LaSalle-Peru Social Science (Control)	Mean	62.922	66.000	3.078
	SD	12.414	12.564	
	N	78	78	
United Township High School Science (Control)	Mean	63.909	63.412	-0.497
	SD	10.498	12.000	
	N	17	17	
United Township High School Environmental Education (Control)	Mean	64.136	62.570	-1.386
	SD	12.313	11.233	
	N	48	48	

*F = 4.377, $P < .01$, $N = 279$; Range = 84 (12 to 96) 112 to 892

All CREATION post hoc-modified LSD comparison (SPSS Version) were significant beyond the .05 level of significance using difference mean gain comparisons. CREATION vs. LaSalle-Peru THIS Science; CREATION vs. LaSalle-Peru Science; CREATION vs. United Township High School Science; CREATION vs. United Township High School Environmental Education classes. All 1975-76 post hoc comparisons significantly favored the CREATION group.

LSD comparisons refer to the modified Least Squared Difference statistical program for post hoc comparisons found in Statistical Programs for the Social Sciences (SPSS) Norman Nili, et.al. Second Edition, 1975, p. 427.

The Test of Reasoning In Conservation Test was used in the 1976-77 school year only. It was designed as a "fact/understanding" test, and used for pre/post test comparisons. All control of test administration, data analysis and test interpretation used in the other two tests were applied to this instrument. The results are noted in Table 2. Note may be made of the post hoc comparisons utilizing the LSD procedure (least squared differences).

Table 2

Pre and Post Test Mean Standard Deviation and Mean Gain Scores
Test Of Reasoning In Conservation
1976-77 School Year

		<u>Pre</u>	<u>Post</u>	<u>Mean*</u> <u>Gain</u>
CREATION (Experimental)	Mean	18.833	21.727	2.894
	SD	3.841	6.264	
	N	33	33	
LaSalle-Peru THIS Science (Control)	Mean	19.271	19.395	0.124
	SD	5.371	6.895	
	N	81	81	
LaSalle-Peru Social Science (Control)	Mean	22.333	22.693	0.360
	SD	5.761	6.384	
	N	75	75	
ERIE Science/ Environmental Orientation (Control)	Mean	24.094	25.158	1.064
	SD	6.524	6.413	
	N	57	57	

*F = 3.6613, $p < .05$, N = 268; Range = 32 (9 to 41) 20% to 91%

All CREATION post hoc-modified LSD comparisons (SPSS Version) were significant beyond the .05 level of significance using difference mean gain comparisons.

The Level of Environmental Understanding Test was used in the 1975-76 and 1976-77 studies as a measure of student cognitive gains in the universal and category understandings of the course intervention CREATION. Note should be made that the 1975-76 test version and the 1976-77 version were not identical. Locally designed, the instrument was extensively field tested for validity and reliability. Field testing was conducted over a three year period in a variety of settings and with large samples. Expert assistance was obtained in subject matter content, test (item) construction, and statistical analysis. Format, question coverage and norms were updated for the 1976-77 version of the test.

The same testing and analysis conditions were used for the Level of Environmental Understanding Test as were present for the other two tests. Similar standardization procedures were used for the two versions of the LEU Test (See Section V.E. of this report).

Results of the 1975-76 study indicate similar results favoring the experimental group. $F(4,310) = 3.440$, $p < .005$. Complete data is reported in Table 3 which follows.

Table 3

Pre and Post Test Means, Standard Deviations and Mean Gain Scores
for Experimental and Control Groups for the
Level of Environmental Understanding Test
1976-77 School Year

		<u>Pre</u>	<u>Post</u>	<u>Mean* Gain</u>
CREATION	Mean	21.274	27.033	5.761
(Experimental)	SD	6.670	6.348	
	N	57	57	
LaSalle-Peru	Mean	21.454	22.793	1.339
THIS Science	SD	6.949	7.173	
(Control)	N	82	82	
LaSalle-Peru	Mean	25.429	25.948	.519
Social Science	SD	5.879	7.329	
(Control)	N	77	77	
United Township	Mean	26.554	26.111	-0.443
High School	SD	5.750	7.563	
Environmental	N	45	45	
Education				
(Control)				
ERIE Science/	Mean	24.859	27.309	2.450
Environmental	SD	6.276	6.215	
Orientation	N	55	55	
(Control)				

*F = 4.1072, $p < .05$, N = 316; Range = 28 (7 to 35) 17.5% to 97.5%

All CREATION post hoc-modified LSD comparison (SPSS Version) were significant beyond the .05 level of significance using difference mean gain comparisons. CREATION vs. LaSalle-Peru Science; CREATION vs. LaSalle-Peru Social Science; CREATION vs. United Township Environmental Ed.; CREATION vs. ERIE Science/Environmental Orientation.

The Level of Environmental Understanding Test (LEUT) and the Morehead Environmental Awareness Test (MEAT) were used as pre-post test evaluation instruments during the first semester, 1977-78, to obtain third year data. These tests were administered to students in six different Illinois high schools, five of whom were adopters of Project CREATION through the Illinois Diffusion Network. Testing was done as a means of determining if replications of CREATION would achieve statistically significant results.

As is shown in Table 4, which follows, all schools achieved .01 levels of significance on at least one of the instruments.

Table 4

Third Year Data - Replications of CREATION
Pre and Post Test Mean, Standard Deviation, Range, Standard Error, and t-Test
Morehead Environmental Awareness Test (MEAT) and
Levels of Environmental Understanding Test (LEUT)
1977-78 School Year, First Semester

		Pre	Post			Pre	Post
LaSalle-Peru (MEAT)	Mean	60.6104	61.7576	Dixon (MEAT)	Mean	58.8833	67.9138
	SD	9.9593	12.5047		SD	12.4575	10.9042
	N	77	66		N	24	23
	Range	43	58		Range	42	46
	Standard Error	1.1350	1.5392		Standard Error	2.5429	2.2737
	Correlated t-ratio = -0.49923				Correlated t-ratio = -3.28154 (P < .01)		
LaSalle-Peru (LEUT)	Mean	23.6683	28.5857	Dixon (LEUT)	Mean	27.0833	28.9565
	SD	7.5746	6.3713		SD	5.5866	6.0263
	N	77	70		N	24	23
	Range	32	23		Range	22	24
	Standard Error	0.8632	0.7615		Standard Error	1.1404	1.2566
	Correlated t-ratio = -7.20629 (P < .01)				Correlated t-ratio = -2.54887 (P < .05)		
Joliet West (MEAT)	Mean	59.3846	64.9423	O'Fallon (MEAT)	Mean	62.6471	60.2128
	SD	10.7966	13.0792		SD	9.5537	10.0670
	N	117	104		N	51	47
	Range	48	67		Range	45	42
	Standard Error	0.9981	1.2825		Standard Error	1.3378	1.4684
	Correlated t-ratio = -4.52260 (P < .01)				Correlated t-ratio = 1.01666		
Joliet West (LEUT)	Mean	21.0522	25.4062	O'Fallon (LEUT)	Mean	23.8824	26.0000
	SD	6.7041	8.3783		SD	5.4540	6.5794
	N	115	109		N	51	46
	Range	29	65		Range	25	32
	Standard Error	0.6252	0.8025		Standard Error	0.7637	0.9701
	Correlated t-ratio = -6.48884 (P < .01)				Correlated t-ratio = -4.10258 (P < .01)		
Reed-Custer (MEAT)	Mean	58.3913	62.4637	Arlington Heights (MEAT)	Mean	68.1333	77.5714
	SD	10.3136	11.1110		SD	11.0121	11.5673
	N	46	41		N	15	14
	Range	46	50		Range	36	35
	Standard Error	1.5210	1.7353		Standard Error	2.8433	3.0915
	Correlated t-ratio = -2.88405 (P < .01)				Correlated t-ratio = -3.89950 (P < .01)		
Reed-Custer (LEUT)	Mean	21.7447	23.2439	Arlington Heights (LEUT)	Mean	28.3333	31.8571
	SD	5.9944	6.8403		SD	6.3546	4.5549
	N	47	41		N	15	14
	Range	25	27		Range	25	18
	Standard Error	0.8744	1.0745		Standard Error	1.6408	1.2174
	Correlated t-ratio = -1.41545				Correlated t-ratio = -4.24482 (P < .01)		

C. Intended Users/Needs Assessment:

Intended Users - high school students, 9-12, reflecting the socio-economic mix of the host school and who fall in the range of the typical classroom. Diffusion to fifteen Illinois high schools during FY 77-78 indicates a wide acceptability of the course curriculum. A dissemination grant from the Illinois Office of Education for FY 77-78 was awarded for \$79,023. Pre and post-testing of students in diffusion sites is underway.

Control groups included urban groups, fifty percent minority, fifty percent white, small rural school settings and suburban groups.

LaSalle-Peru Township High School has an enrollment of approximately 2,000 students and serves eight public and five Catholic feeder elementary districts. The majority of students live in either LaSalle, Peru, or Oglesby, with approximately nine percent of the students living on farms or in rural settings.

The characteristics of the students enrolled in CREATION are somewhat a function of enrollment strategies. To guard against a handpicked group of students, enrollment in the project program has always been of a voluntary nature, and the program has been listed among the other courses offered by the high school. The counseling staff at LaSalle-Peru Township High School has taken a "non-recruiting" attitude toward the project, and have done nothing to enroll other than those who show genuine interest.

D. Costs for Adoption:

	INSTALLATION Non-recurring Costs	SUBSEQUENT YEARS (Recurring Costs)
Staff Training	\$325	none
Special Facilities	none	none
Equipment	none	none
Consumables	\$190 curriculum	cost basis as curriculum needs to be replaced
Other Costs		
TOTAL COSTS	\$515	costs can differ due to local considerations

The costs of adoption reflected in the chart above are based on adopting/adapting the curriculum with one teacher in a classroom with 25 students.

E. Interpretability of the Quantitative Measures: Three instruments were administered both pre and post-tests to experimental and control groups. Manuals describing each of these instruments are available. Summaries are included below:

Morehead Environmental Awareness Test - This test is the result of a study funded by the Office of Environmental Education, Department of Health, Education and Welfare. It was designed as part of a comprehensive study on the status of environmental awareness in a 49 county area of eastern and southcentral Kentucky. The test was administered to 7,796 high school students in the spring of 1972. There are 36 questions on the instrument, three of which concern personal data.

Six were opinion questions and 27 were cognitive in nature. The test is scored based on a predetermined number of points for each possible answer. These scores of the 7,796 secondary school students ranged from 19 to 95 (17.50 to 87.96 percent) out of a possible 108 points, with a mean of 60.10 (55.65 percent).

In addition to the original testing program of 7,796 students the Morehead Environmental Awareness Test has been found to have a high correlation ($r = .78$) with the Test of Reasoning in Conservation Test using the Pearson Product-Moment Correlation Coefficient. *Correlation with a locally designed instrument, Level of Environmental Understanding Test, also indicates a high positive relationship.

Test of Reasoning In Conservation - This test was developed by the Conservation Foundation in cooperation with Educational Testing Service, Princeton, New Jersey. Two purposes are defined: "...to learn what students have learned about important aspects of conservation," and "to provide classroom teachers with a clear picture of what conservation specialists and experienced teachers of conservation believe to be the desired scope and objectives of such education."

The test was written "for an essential concept of facts," and to "probe students' understanding of the implications of problems in conservation..." The test was administered on a state-wide basis in 1959-60 to grades 9-12 in 36 schools in the state of Oregon. Percentile ranks, mean and standard deviation are available for those in the Oregon test. Coefficients of reliability have been computed using Kuder-Richardson Formula 21. Forms A and B vary from .74 to .84. The standard errors of measurement vary from 2.97 to 3.24. Since its original piloting in Oregon, the test has been used in 36 high schools in 17 states, and 11 colleges in 9 states.

Levels of Environmental Understanding - This locally developed instrument has been designed to reflect the universal and category understandings of the course intervention.

Reliability of the test has been established on a test-retest basis, using a random sample of 40 students at L.P.T.H.S., ten from each grade level, equally divided between male and female. Subjects were tested and then retested after an eight day interval, using a different form of the original instrument. Pre-test mean was 28.825, median was 28.166 and range was 18. On the post-test the mean was 29.550, the median was 30.500 and the range was 26. The standard error of the difference between the mean scores on test-retest was not statistically significant.

All evaluation instruments used in measuring cognitive environmental understanding have undergone analysis by item in terms of their relevance to the course intervention, as reflected in the universal and category objectives.

A summary of the "fit" of evaluation instruments to the course intervention is given as follows:

1. Morehead Environmental Awareness Test - Of the 27 items, one item is judged to have a weak fit with the course intervention, although all are related to the field of environmental education.

*The Journal of Environmental Education, "Environmental Awareness Determination: A Model," J.F. Howell, Volume 6, Number 2, Winter, 1974, p. 57-63.

2. Test of Reasoning In Conservation - Of the 45 items in both Form A, Form B, 18 and 9 items respectively are judged to have a weak fit with the course intervention, although all are related to the field of environmental education.
3. Levels of Environmental Understanding - Of the 40 items, all are judged to fit with the course intervention, and all are related to the field of environmental education.

The results of testing on the three evaluation instruments are summarized in Tables 1, 2, and 3. Results show CREATION students out-perform control students at .01, .05, and .05 levels of significance respectively in cognitive gains.

- F. Credibility of Evidence: Data collection within LaSalle-Peru Township High School were under the supervision of Mrs. Jean Hauser, Project Director. All staff members who assisted in the collection of data are certified teachers. All staff members, and Dr. Arthur Yonke who collected data in the "outside" control groups, used a uniform set of instructions with each evaluation instrument, uniform tests, and uniform answer sheets. All test materials and original answer sheets are available. No special training was required to administer evaluation instruments. The same staff members administered both pre and post-tests to particular groups. All data were key-punched, verified each subject, their scores, and selected scoring patterns.

VI. Evidence of Effectiveness:

- A. Evidence that Something Happened: The evaluation design was a pre/post comparison utilizing control groups in a high school of less than 400 (Erie H.S.), and a high school of more than 3,000 (United Twp. H.S.). Tested groups were in related subject disciplines and in environmental education classes. Evidence of effectiveness was based on three evaluation instruments used during different evaluation periods (1975-76 and 1976-77).

The results of two years of replicated study have uniformly and significantly favored CREATION students over those in control groups. In addition, surveys of key community informants, parents, and teachers were conducted in order to ascertain their perceptions regarding Project CREATION. The results of all inquiries indicated a positive image in evaluative, potency and activity dimensions. Also, all three groups of target area respondents ranked environmental education as a higher priority than did non-target respondents.

- B. Evidence of Statistical Reliability: Testing was conducted by Dr. Arthur Yonke, Western Illinois University, and project staff; data were analyzed by the project evaluator utilizing the Augustana College computer terminal from the University of Iowa, Iowa City, Iowa.

Participants were high school students from three districts in various parts of Illinois. Experimental and control groups included all students who took both pre and post-tests. Matching of experimental and control groups was based on I.Q. comparisons (data available from district reports), mobility data, merit scholar production, and selected teacher variables as measured by a twenty-seven item position survey on ecology.

During the second year of the project data was gathered using the Morehead Environmental Awareness Test. During the third year the Morehead was used along with the Levels of Environmental Understanding, and the Test of Reasoning in Conservation. All tests were administered to all groups on a pre/post basis.